(12) UK Patent Application (19) GB (11) 2 124 111 A

(21) Application No 8317414
(22) Date of filing 27 Jun 1983
(30) Priority data
(31) 3223748
(32) 25 Jun 1982
(33) Fed. Rep of Germany (DE)
(43) Application published
15 Feb 1984
(51) INT CL³
B23B 31/40
(52) Domestic classification
B3B 2R 2Y2A1 6
(56) Documents cited
GB 1398085
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GB 0623541
WO A 8001258
(58) Field of search
B3B
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(54) A chuck for clamping a hollow workpiece

(57) The chuck comprises a tubular mandrel (13') having several jaws (12) machined from a tubular member. The inner surface 22 of the jaws (12) forms a frusto-conical surface for cooperating with a clamping wedge 15'. The jaws are axially connected at their ends to end portions (18 and 19') of the mandrel by respective radially flexible webs (17). Axial movement of the clamping wedge (15') causes flexing of the webs (17) so that the jaws (12) move radially outwards. The clamping wedge (15') carries a spigot (30) arranged for axial adjustment inside an adjustable bush (35). To retain the chuck on the lathe (10) the bush (35) is clamped to the chuck. The clamping wedge (15') carries the tubular mandrel 13'.

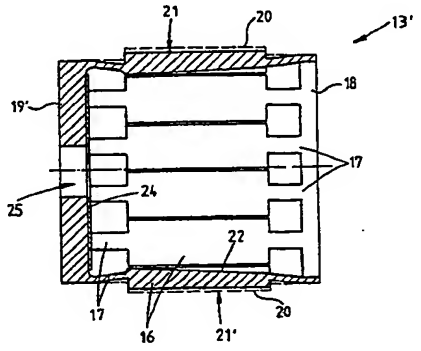

Fig.2

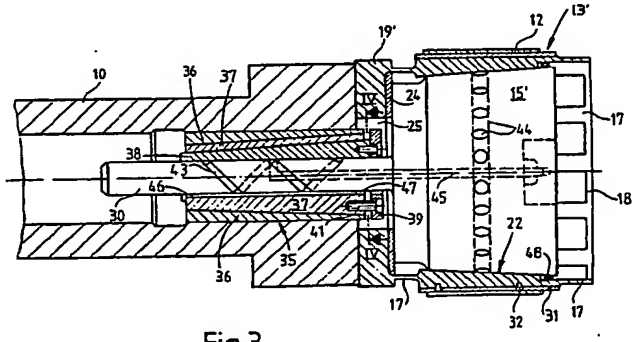

Fig.3

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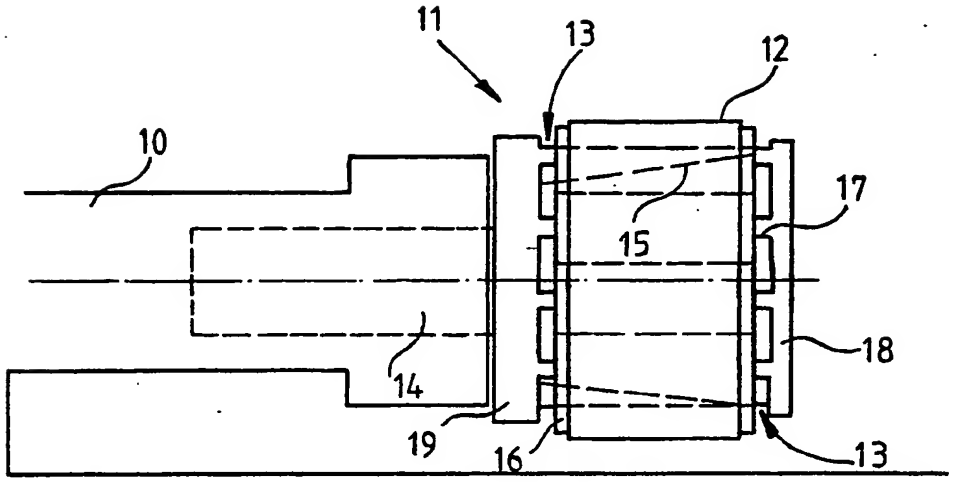

Fig.1

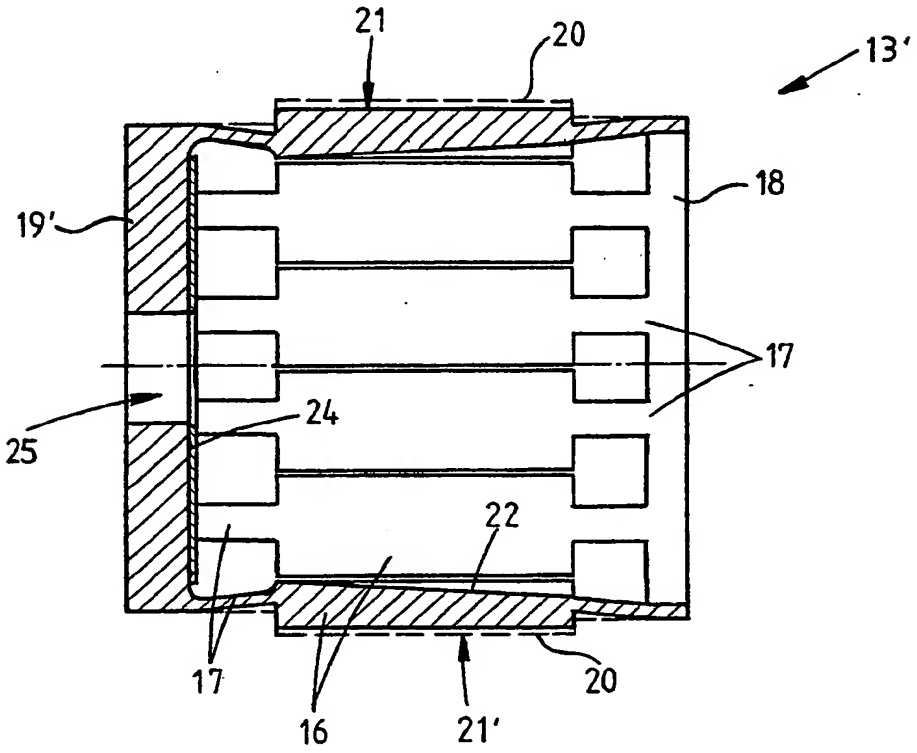

Fig.2

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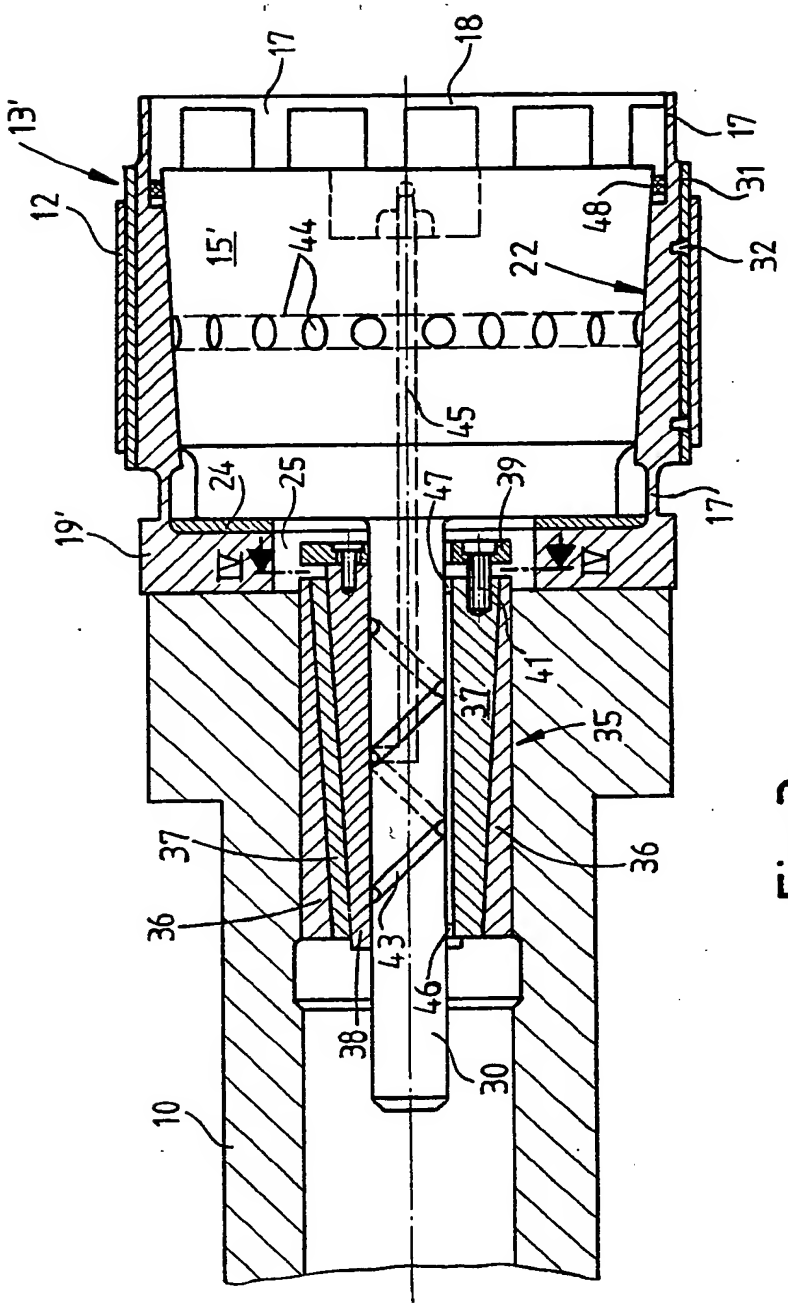

Fig.3

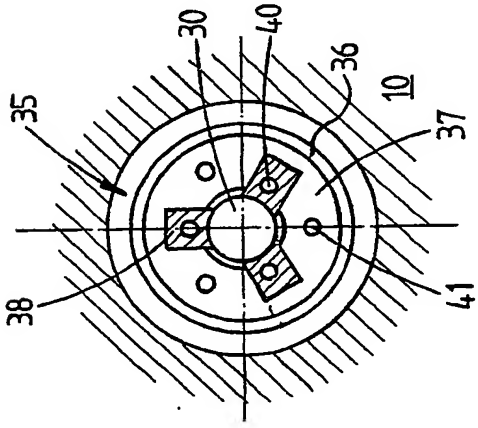

Fig.4

SPECIFICATION

A chuck for clamping a hollow workpiece

This invention relates to a chuck for a lathe for clamping a hollow workpiece, comprising a mandrel for engaging the interior of the workpiece and having circumferentially equally spaced, radially movable jaws.

A device of this description has been disclosed in German Utility Model No. 78 10 680. The clamping members of this device are radial plungers radially pressurized jointly and at the same pressure level by means of fluid pressure. This arrangement serves to clamp, for machining purposes, a hollow body of slightly varying diameter without causing changes in its original form.

There are many applications, however, in which circularity and centricity must be as exact as possible even if small irregularities in the form of the workpiee can be eliminated during clamping.

An object of the present invention is to provide a chuck by means of which maximally centric clamping of the workpiece may be obtained.

The invention provides a chuck for clamping a hollow workpiece, comprising a mandrel for engaging the interior of the workpiece, wherein the mandrel is tubular in shape and is subdivided between the ends of the tube into at least two jaws, the jaws being connected to tube end portions by means of respective webs allowing radial movement of the jaws, the jaws defining a cylindrical outer surface for contacting the hollow workpiece, and a frusto-conical inner surface an axially slidable, frusto-conical clamping wedge being provided to cooperate with the said inner surface and urge the jaws radially outwards.

Mechanical cooperation of the various components ensures reproducible clamping by the chuck. If the chuck is machined with the requisite accuracy, the workpiece can be clamped on the lathe with a minimum of runout. In the unclamped condition the mandrel is smaller in diameter, permitting the workpiece to be easily seated over it and to be clamped by axial movement of the clamping wedge. This permits the workpiece to be changed quickly, as is desirable in quantity production or other applications.

The chuck of the present invention does not require complex sealing provisions commonly associated with hydraulically-operated chucks.

Preferably, the jaws and the respective webs are cut directly from a tubular body. It is advantageous to draw the clamping members radially inwardly towards the interior of the tubular member, such that in the tensioned position the outer circumference around the clamping member exhibits the original diameter of the tubular member. In this manner the outer surface of the tubular body can be machined in the jaw area to the final size of the mandrel before the jaws or the webs are formed. This permits the mandrel to be manufactured with a high degree of accuracy.

Preferably the jaws are surrounded by a flexible compensating bush or sleeve, so as to allow for any runout of the mandrel when clamped on the lathe; the compensating bush can be machined in its expanded condition.

In order to ensure a reproducible diameter of the mandrel in the clamped condition, a stop for the clamping wedge is provided at one face of the tubular member.

The mandrel may be fitted by simple manufacturing provisions with a spigot for clamping the mandrel on the lathe.

Alternatively, the spigot for locating the mandrel on the lathe may be provided on the clamping wedge. In this arrangement the spigot simultaneously serves as a guide for the axial displacement of the clamping wedge when the mandrel is being clamped or loosened.

In another preferred aspect of the present invention the spigot on the clamping wedge is associated with a bush to receive the spigot in its axial movement. This permits the clamping wedge to be secured for axial sliding movement within the chuck of the lathe; the bush also serves as a guide for the clamping wedge.

The bush preferably comprises two telescopically-slidable sleeves, the contact surfaces of which are given a frusto-conical shape, the inner sleeve taking the form of a clamping sleeve. Preferably for ease of manufacture, the clamping sleeve consists of at least three axially movable jaws. Axial movement of the clamping sleeve within the outer sleeve permits the inside diameter accepting the spigot to be varied. This will permit the inner diameter to be adjusted acurately to suit the outer diameter of the spigot of the clamping wedge such that no clearance remains between the spigot and the bush and that runout is reduced to a minimum.

For locating the adjusted jaws of the bush, one face of the bush may be provided with a ring carrying several screws partially engaging in the face of the outer sleeve and the respective jaws. The inside diameter of the jaws is controlled by adjusting the screw spacing.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a side view of a firs embodiment,

Figure 2 is a sectional detailed view of a modified embodiment of Figure 1,

Figure 3 is a sectional view of a further embodiment, and

Figure 4 is a cross-sectional detailed view taken along the line $\overline{IV}$ - $\overline{IV}$ of Figure 3.

In Figure 1, a chuck 11 is arranged on a lathe 10 for clamping a hollow workpiece or pipe 12 so that it can be machined externally. The chuck 11 comprises a mandrel 13, clamped in place on the lathe 10 by means of a spigot 14, and a wedge 15.

In Figure 2, a mandrel 13' has several jaws 16 machined from a tubular member. The jaws 16 are radially flexible and are connected at one end to an integral annular end piece 18 and at the other end to an integral disc-shaped end piece 19 by means of webs 17. For manufacturing the mandrel 13', a tubular steel member of an outer circumfernce 20 shown in broken line is machined to bring its shell 21 in the jaw area to the accurate dimension of the inside diameter of the workpiece. The bore 22 of the jaw area is given a frusto-conical shape. The jaws 16 and webs 17 are finally formed by machining the tubular member.

The jaws 16 are then drawn inwards relative to the end pieces 18, 19' so that the diameter of the outer shell of the jaws is reduced to the circumference 21. In this manner the workpiece 12 can readily be seated over the mandrel 13' and clamped by insertion of the clamping wedge 15. The jaws 16 are forced outwards to their original outside circumference 21' so that the jaws 16 bear fully against the workpiece 12 with their outer surface 21 once their radius of curvature equals the radius of the tensioned shell 21'. In this manner the workpiece 12, which fits snugly all around, can be accurately machined.

It will naturally also be practicable to manufacture the jaws separately and weld or otherwise connect them to connecting rings. Any runout arising can then be eliminated by machining the outer shell of the jaws in the tensioned condition.

In order to achieve a reproducible diameter of the mandrel 13° in the tensioned condition, the end disc 19° of the mandrel 13° serves as a stop for the clamping wedge 15. The end disc 19 is provided with a shim 24 the thickness of which is varied for accurately controlling the depth to which the wedge is inserted. Also inaccuracies arising from wear in operation can be eliminated by replacing the shim 24.

When the mandrel 13 is designed in accordance with Figure 1 the one end piece 19 simultaneously serves to support the spigot 14. Whereas in the embodiment of Figure 2 the end piece 19' is provided with a hole 25 to receive a spigot on the clamping wedge.

The embodiment shown in Figure 3 comprises a mandrel 13' in accordance with Figure 2 and a clamping wedge 15' having a spigot 30. Provided on the outside circumference of the jaws 16 is a flexible compensation bush 31 in aluminium which may, e.g. be secured to the mandrel 13' by means of two screws 32. The compensation bush 31 serves to counteract any inaccuracy and eccentricity arising in the manufacture of the chuck, so that once the chuck is completed, the compensation bush 31 is machined in the tensioned condition of the mandrel 13' to minimise runout. In this case the outside diameter of the compensation bush equals the inside diameter of the workpiece 12 to be machined.

For positive fixation of the spigot 30 within the chuck of the lathe 10, a bush 35 is provided which consists of an outer sleeve 36, a central sleeve 37 and three jaws 38. The abutting surface between the outer sleeve 36 and the central sleeve 37 has a frusto-conical shape. The jaws 38 are essentially rectangular in section and also have a longitudinal tapered shape.

A ring 39 is also provided to retain the jaws 38 longitudinally with respect to the central sleeve 37 so that the jaws 38 accurately envelope the spigot 30. For locating the ring 39, screws 40 each engaging in a jaw 38, and locating screws 41 engaging in the inner sleeve 37, are provided.

Using the accurately adjusted jaws 38 the spigot 30 and, thus, the wedge 15' connected thereto, can be centered to minimize runout. The absence of runout of the wedge 15' is finally transferred to the mandrel 13', which is held and supported by the wedge 15'. Finish machining of the compensation bush 31 will then eliminate any remaining inaccuracies not only of the mandrel 13' but also of the wedge 15' and of its fixation in the bush 35 or in the head of the lathe 10.

The wedge 15' with its spigot 30 is arranged for axial adjustment so that the mandrel 13' can be tensioned and released for replacement of the workpiece 12. This can be achieved mechanically at the wedge or spigot end or pneumatically at the spigot end. For lubricating the sliding surfaces within the bush 35 and the mandrel 13', lubricating oil ducts 43 and 44 are provided to receive oil from a common lubricating oil duct 45. Seals 46, 47 and 48 prevent the oil from escaping.

CLAIMS

1. A chuck for clamping a hollow workpiece, comprising a mandrel for engaging the interior of the workpiece, wherein the mandrel is tubular in shape and is subdivided between the ends of the tube into at least two jaws, the jaws being connected to tube end portions by means of respective webs allowing radial movements of the jaws, the jaws defining a cylindrical outer surface for contacting the hollow workpiece, and a frusto-conical inner surface an axially slidable, frusto-conical clamping wedge being provided to cooperate with the said inner surface and urge the jaws radially outwards.

2. A chuck as claimed in claim 1, wherein the jaws and the respective webs are machined directly from a tube.

3. A chuck as claimed in claim 1 or 2, wherein the jaws extend radially inwards into the interior of the mandrel.

4. A chuck as claimed in any one of the preceding claims, wherein the jaws are surrounded by a flexible compensation bush.

5. A chuck as claimed in any one of the preceding claims, wherein the mandrel has a stop limiting axial movement of the clamping wedge.

6. A chuck as claimed in any one of the preceding claims, wherein the mandrel has a spigot by means of which the chuck may be clamped in the head of a lathe.

7. A chuck as claimed in any one of claims 1 to 5, wherein the clamping wedge has a spigot by means of which the chuck may be clamped in the head of a lathe.

8. A chuck as claimed in claim 7, wherein the spigot is provided with a bush within which the spigot is axially movable.

9. A chuck as claimed in claim 8, wherein the bush comprises two telescopically axially-movable sleeves having frusto-conical contacting surfaces, the inner sleeve being shaped to form a clamping sleeve.

10. A chuck as claimed in claim 9, wherein the clamping sleeve of the bush comprises at least three axially-movable jaws.

11. A chuck as claimed in any one of the preceding claims, wherein the clamping wedge has ducts for lubricating oil.

12. A chuck for clamping a hollow workpiece substantially as herein described with a reference to any one of the embodiments shown in the accompanying drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1984.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.